the process which leads to the transfer of the hæmoglobin in the direction of the positive current. This process is considered to be of the same nature as the phenomena studied by Quincke under the name of electro-endosmose.

Special attention was directed to the importance of the facts which the author has elicited in reference to the colloidal yet soluble form of oxy-hæmoglobin. It was pointed out that all which has been said with regard to oxy-hæmoglobin applies to CO-hæmoglobin.

A typical colloid in the sense of its absolute indiffusibility through animal membranes and parchment paper, oxy-hæmoglobin differs, however, from most colloids in the facility with which it crystallises. Hitherto it has been known in its crystalline condition and in solution in water. Now in its third or colloidal form the analogy with such a colloid as silicic acid is rendered complete.

The discovery of this form of hæmoglobin enables a conception to be formed of the state in which the blood colouring matter is probably contained in the blood corpuscles. It was known that the amount of hæmoglobin contained in the corpuscles is so large that in most animals at least the whole of the water of the blood would not be sufficient to dissolve it. It was perfectly obvious, therefore, that it did not exist in the corpuscles in a state of solution, and the opinion has generally been held that these contained some unknown compound of oxy-hæmoglobin with a constituent of the stroma. It seems highly probable that in the red blood corpuscle hæmoglobin may be merely present in its colloidal form.

Finally it was pointed out that the remarkable facility with which the new colloidal form of hæmoglobin traverses such permeable membranes as the animal membranes and even parchment paper, when its solutions are subjected to electrolysis, suggests to physiologists the possibility that certain of the phenomena of absorption in the animal body may be closely connected with electromotive changes in the tissues concerned.

QUANTITATIVE INVESTIGATIONS OF BIOLOGICAL PROBLEMS.

THE first part of the new publication, *Biometrika*, was noticed in these columns on December 5, 1901 (vol. lxv. p. 106). The second part, which we have now received, bears out the promise of its founders and shows that the new quantitative methods of investigating biological problems have every claim to rank as legitimate weapons of research. The present part contains five original communications and a number of miscellanea. Dr. Warren's paper on "Variation and Inheritance in the Parthenogenetic Generations of the Aphis *Hyalopterus trirhodus*" shows that variation within the family is 60 per cent. of the racial variation, that the offspring have no greater resemblance to the mother than in sexual reproduction, but that there may be a somewhat greater fraternal resemblance than among the offspring of sexual reproduction. Mr. W. P. Elderton, in a paper entitled "Tables for Testing the Goodness of Fit of Theory to Observation," provides a set of tables useful alike to physicists, biometricians and statisticians generally who want to ascertain rapidly whether the distribution of observed data, within the limits of "a sample," is in agreement with a proposed theory. Mr. Oswald Latter, as the result of measuring 243 eggs of cuckoos and comparing them with the eggs of the clutches in which they were deposited, has come to the conclusion that there is colour-matching in 50 per cent. of cases, and in certain of the remaining cases size-matching. The bearing of these results upon Prof. Newton's theory is considered, and that theory is shown to receive confirmation therefrom. The next paper, by Dr. W. R. Macdonell, has great practical interest in connection with criminal anthropology. The author has studied the index characters hitherto used in the identification of criminals, and now shows that there is a high degree of correlation between the organs selected. He indicates the best method of dealing with the measurements, and gives suggestions for calculating uncorrelated characters "which would furnish an ideal system of identification." In connection with that most important topic, the laws of inheritance in hybrids, Prof. W. F. R. Weldon gives an account of Mendel's results of crossing races of peas which differed in one or more of seven characters. To quote the abstract of this paper:—"From a study of the work of other observers, and from examination of the 'telephone' group of hybrids, the conclusion is drawn that Mendel's results do not justify any general statement concerning inheritance in cross-bred peas. A few striking cases of other cross-bred plants and animals are quoted to show that the results of crossing cannot, as Mendel and his followers suggest, be predicted from a knowledge of the characters of the two parents crossed without knowledge of the more remote ancestry."

The notes published under the miscellanea comprise one from Prof. C. B. Davenport in which he shows that in an "abnormal" species of Hydromedusæ, *Pseudoclytia pentata*, it appears that the less typical an individual the less its fertility, and irregular individuals are more sterile than those having some sort of symmetry. The typical form and symmetry thus tend to by preserved. Prof. Karl Pearson, from a comparison of the eggs of English and American house-sparrows, is enabled to warn biometricians "against drawing conclusions from types based on the 'modes' exhibited by small samples of living forms." In another note he also shows from mummy statistics furnished by Prof. Flinders Petrie that there has been a great increase in the expectation of life since the 2000 years which have elapsed from the Romano-Egyptian epoch. Out of 100 modern English alive at ten years of age, thirty-nine survive to be sixty-eight, while not nine survived out of 100 Romano-Egyptians. Prof. Pearson also contributes a note "On the Modal Value of an Organ of Character." Miss Agnes Fry writes on variation in leaves of mulberry trees, and gives illustrations of the leaves of eight trees of different ages. From this summary of its contents it will thus be seen that the new publication is fully entitled to that support which we urged in our notice of the first part.

THE KOZLOFF EXPEDITION TO TIBET.

THE last number of the *Izvestia* of the Russian Geographical Society (1901, iv.) contains a series of very interesting letters of Captain Kozloff, the head of the last Tibet expedition. They cover the most important part of his journey, from May 1900 to October 1901, during which Kozloff and his companions, Kaznakoff and Ladyghin, explored a quite unknown country, situated between the 36th and 29th degrees of latitude and 97–99° E. longitude. A preliminary map, 27 miles to the inch, illustrates these letters.

The expedition left Tsaidam in May 1900, after having organised a meteorological station at the old Tsaidam fort, Barun-tsasak (36° 5′ N. lat., 97° 30′ E. long., 8700 ft. alt.). It crossed the high border ridge, Burkhan budda, which runs N.W. to S.E., separating the high plains of Tsaidam from the high plateau of eastern Tibet, and reached the twin lakes of the upper Hoang-ho, Jarin-nor and Orin-nor, or Lakes Expedition and Russian, as they were named by Prjevalsky. The border ridge consists here of two parallel chains, the passes through which attain the respective heights of 15,700 and 15,600 feet, while separate peaks rise another 500 or 600 feet above the passes. Under the name of Amne-machin, it is continued further S.E. in the same direction, the Hoang-ho running on the high plateau at the south-western foot of the border-ridge.

The intention of Kozloff was to explore Inner Tibet and, if possible, to reach Hlassa; but as soon as they entered the territory of Hlassa, their route was barred by a military force. Yielding to the demands of the authorities, the expedition abandoned its intention of penetrating further west, and went southwards, with the intention of visiting the Chamdo (or Tsamdo) monastery; but its route was again and again barred by military detachments, so that finally Kozloff turned eastwards, under the 30th degree of latitude, and wintered on the Dza-chu, a tributary of the Mekong, thirty miles north of Chamdo. Later on, in the spring, he crossed once more the high range of mountains which, running N.W. to S.E., separates the Mekong from the Blue River, and reached this last under the 30th degree of latitude. There the expedition made the necessary preparations for the return journey, which was resumed in April 1901, exploring the Amne-machin region on the left bank of the Yang-tse, and returning eventually to the upper Hoang-ho lakes.

Having thus described a wide curve in Tibet, the Kozloff expedition explored lands totally unknown, where the three great rivers—the Hoang-ho, the Yang-tse, and the Mekong—descend from the high Tibet plateau to the lower regions of China, and which represented a real puzzle in the orography of Asia. It

now appears that the three rivers flow on the surface of the 12,000 feet high Tibet plateau, and are separated—not by fan-like radiating mountain ranges, but by ranges of mountains rising some 3000 feet above the plateau and all running parallel to each other, N.W. to S.E. In its western portion, the high plateau, deprived as it is of the rains of the monsoon region, is a dreary desert, covered with shingle; but in its south-eastern portion, the character of the plateau changes entirely. A deep erosion makes of it an alpine mountain region. Wide valleys and deep gorges alternate with stony ridges; the routes and the footpaths go down to a deep level, or lead to great relative and absolute altitudes. Regions of soft and of rough climate, of rich and extremely poor vegetation, rapidly alternate. This alpine character already appears in the basin of the Blue River, but it is still more evident in the basin of the Mekong, where the valleys are still deeper and their vegetation still more varied. Forests of fir and of a tree-like Juniperus make their appearance, as also growths of birch, wild apricots, apple trees and a variety of bushes. In the thickly wooded gorges, the expedition also found the conspicuous white Tibet pheasants (*Crossoptilon thibetanum*), the green *Ithaginis Geoffroyi*, the *Tetraophasis obscurus*, *Tetrastes Sewertzowii*, several species of blackbirds and a good number of the smaller birds of the Passeres group. On a bright clear day the forests and the meadows are full of bird-life. Small colonies of monkeys stay in close proximity to the Tangute encampments.

On June 13 the expedition reached at last the two lakes Orin-nor and Jarin-nor, whence it proceeded to Tsaidam, and then once more across the Gobi, back to Kiakhta. It appeared that everything was in order at the meteorological station, where regular observations were made for a full year. As to the collections made in Tibet, they were very rich and contained no less than 120 mammals, 600 birds, more than 600 species of plants (10,000 specimens) and about 300 specimens of rocks. Latitudes and longitudes were determined in thirteen different spots. The expedition is now back at St. Petersburg. P. K.

CATALYSIS.[1]

THE idea and name of catalytic action were introduced into science by Berzelius in 1835, apropos of Mitscherlich's work on the formation of ether. Berzelius pointed out that the action of sulphuric acid in this case was analogous to the action of dilute acids on starch, to the similar action of malt extract, to the decomposition of hydrogen peroxide by metals and oxides, and to the action of platinum on combustible mixtures of gases. According to Berzelius, catalytic force appeared to consist essentially in this, "that substances by their mere presence and not by their affinity have the power to rouse latent affinities, so that compound substances undergo reaction and a greater electrochemical neutralisation occurs." Berzelius made no attempt to explain the phenomenon; on the contrary, in a subsequent discussion with Liebig, he insisted on the great danger of attempting to explain incompletely understood phenomena by hypothetical assumptions, lest experimental investigation should thereby be hindered. Berzelius' warning was not heeded, and the neglect of it is felt to the present day.

Catalytic actions may be divided into four classes:—(1) Release in supersaturated systems. (2) Catalysis in homogeneous mixtures. (3) Heterogeneous catalysis. (4) Enzyme actions.

(1) This first division includes phenomena which may be regarded as fundamentally explained. The best-known case is the crystallisation of a supersaturated solution, for example, of Glauber's salt, by the admission of a very small trace of the solid substance with respect to which the solution is supersaturated. We notice here in the first place the characteristic disproportion between the quantity of the acting substance and the quantity of substance changed by its influence. By a particle of dust far below the limit of what is ponderable, it is possible to bring an indefinitely large quantity of supercooled solution to congelation. The smallest particle which suffices is between 10^{-10} and 10^{-12} gramme. The processes are not limited to supersaturated solutions of solids; they are applicable also to solutions of gas. In these cases a trace of a gas may cause the liberation of an entirely disproportionate amount of another gas. Then again, supersaturation is not limited to the liquid state. Vapours can be supersaturated in respect to liquids and solid bodies, and even in the case of solids, cases are known where they are supersaturated in respect to liquids, that is to say that when they are in contact with a small quantity of liquid in question they are converted into liquid. Supersaturation on the part of solid bodies in respect to the solid bodies which can be produced from them are very common. On the contrary, supersaturation of a liquid in respect to another liquid has not been observed and would be difficult to obtain.

The theory of all these phenomena is known. In all cases we have the formation of a system the stability of which is not the greatest possible under the given conditions of temperature and pressure. There are, on the contrary, other more stable conditions which are characterised by the fact that in them a new phase, that is a physically different component with other properties, makes its appearance. In the case of a supersaturated solution of Glauber's salt, this is the solid salt; in supersaturated soda-water, it is carbonic acid gas. As a rule such a new phase does not appear spontaneously if the supersaturation is not too great, and the system behaves as if it were in equilibrium; but if a small quantity of the absent phase comes in contact with the metastable system, the action is set going and the new phase increases until equilibrium is reached.

If the new phase is a solid substance, the releasing action is associated with a solid nucleus of the same composition. Isomorphous substances have also the property; other solid bodies, on the other hand, are without action. There is here opened a wide field for investigation, since isomorphous substances probably act by the formation of solid solutions, and it is to be ascertained whether solid substances which are not isomorphous with the substance concerned, but are capable of forming solid solutions with it, are active. Further, there are cases where solid bodies act without being isomorphous or without forming solid solutions. Such artificial nuclei can be prepared, for example, by allowing silicic acid to deposit in presence of a crystal and then dissolving the crystal by means of a suitable solvent. This subject has not been fully investigated, but it explains many apparent contradictions that have occurred in the investigation of this difficult subject. Whilst the nuclei in cases of supersaturation in reference to a solid phase must be of a specific nature, in the case of supersaturation with gases any gas whatever will act as a nucleus. This is in consequence of the fact that every gas dissolves without limit in every other gas, that is, forms a homogeneous mixture with it.

A given liquid can be simultaneously supersaturated with respect to different phases, for example, one can easily melt together sodium acetate and sodium thiosulphate to form a liquid, from which, by the addition of a nucleus of either salt, that salt is separated, whilst the other remains dissolved.

Supposing we had such a liquid flowing through a tube at one point of which was a nucleus of acetate and at another of thiosulphate, then each nucleus would continue to grow in its own way as the liquid circulated. We have here an example of the physicochemical possibility of certain organic processes to which Berzelius alluded, such as the formation of the most different substances in the animal body from one and the same liquid, namely the blood. If we might consider the blood as a supersaturated solution in respect to all these substances, it would be intelligible that every organ could increase its substance from one and the same liquid. It would be inadmissible to suppose that we have here a general theory of animal secretion, for the consideration only applies to heterogeneous phases.

Again, there is the question as to whether a compound which does not preexist in the liquid, but can only come into existence by the action of contained substances, is capable of exhibiting supersaturation in regard to other phases in contact with it. There are phenomena of supersaturation known to us in connection with calcium sulphate, solutions of which are so dilute that the salt must be almost entirely in the form of its ions. Since there are no ions in the solid salt there must be here a chemical change. Dilute solutions of lead salts and thiosulphates likewise show a supersaturation in respect to lead sulphide, which is formed from them by complicated chemical decomposition. Finally, the "physical development" in photography affords examples of such phenomena.

Further examples of possible physiological applications can-

[1] The phenomena of catalytic action have been the chief subject of investigation by Prof. Ostwald and his pupils during the past few years. An account of the chief results so far obtained, together with a statement of his own views of the general character of catalytic phenomena, was given by Prof. Ostwald in September last to the German Naturforscher-Versammlung at Hamburg. What is here given is a slightly abridged translation of this address.—A. S.